Mapping Physical Network Roles to Relative Abstract Roles in Financial Models:

Measuring Business Characteristics for Internet-based Services

Simon Evenepoel, Marlies Van der Wee, Sofie Verbrugge, Bart Lannoo, Mario Pickavet
Dept. of Information Technology (INTEC)
Ghent University – iMinds
Ghent, Belgium

{Simon.Evenepoel, Marlies.VanderWee, Sofie.Verbrugge, Bart.Lannoo, Mario.Pickavet}@intec.ugent.be

Abstract

In the current telecommunications domain, a clear trend towards vertical disintegration is observed, whereas multiple actors take up different roles in the value chain instead of one monopoly operator that is responsible for the full service delivery. Although this trend is observed in different network technologies (fixed, wireless, mobile, satellite) and for different applications (digital TV, mobile applications, health services, etc.), cross-domain case comparisons are hard to make due to the distinct definitions of roles and actors. However, despite this lack of common framework, clear similarities exist that could make room for a qualitative comparison of the different interaction models, which is the scope of this paper.

By defining relative abstract roles (offer, delivery platform and support platform) and the interactions between these roles as revenue streams, different financial models are identified. By mapping them on physical network roles in specific cases, these financial models are analyzed with respect to business characteristics such as innovation, competition, sustainability and standardization. The paper concludes that Over-The-Top financial models stimulate standardization, while Single Interaction Point models are more sustainable and hence support technological innovation. Indirect Support models balance out advantages and disadvantages of the two other types of models, and are therefore more neutral.

Keywords

Multi-Actor Analysis, Telecommunications, Financial model

1 INTRODUCTION AND MOTIVATION

Although the first communication initiatives like telegraph and telephone were exploited by private companies (e.g. the International Bell Telephone Company (I.B.T.C.) [2], the need for universal access and service made the government soon take over the responsibility of deploying telephone networks and offering voice services. In many European countries (e.g. Belgium, the UK, the Netherlands, etc.) one monopoly company was responsible for all communications for almost a century. However, at the end of the 1980s, the European Commission initiated discussions for the development of a common market for telecommunications [3], leading to (partial) privatization of the incumbent companies, and liberalization of the market. Not only were voice and internet services allowed to be offered through the former analogue television networks, unbundling obligations and bitstream access allowed new players to enter the market without incurring the risk of high investment in infrastructure.

Furthermore, the introduction of broadband services made other types of players emerge, offering all types of internet-based applications, thereby explicitly (or implicitly through so-called Over-The-Top applications) using the existing networks of copper or cable incumbents. As such, in the current telecommunications industry, we observe a trend towards splitting up the responsibilities in the network (functional separation, vertical disintegration, open access), allowing more market players to cooperate and compete on the same network infrastructure [8], [10]. In previous papers [4], [9], we studied the impact of these new models on telecommunications access networks. We noticed significant similarities between the models used in fixed and mobile deployments, both in terms of roles, emerging actors and cooperation models. Examples include the identification of the responsibilities of service provider, network provider and physical infrastructure provider, as well as business models on their interaction (e.g. a wholesale model with shared infrastructure and competition on network and service layer, or a vertically integrated model in which all responsibilities are taken up by the same company). On the other hand, notable differences such as the added complexity of the access-backhaul division in mobile networks, and different definitions to the identified roles, made true comparison difficult. Investigating the cooperation models identified, triggered us to dig deeper into the business models of the different actors, as well as their interactions, and making them applicable to a wide range of services and applications.

The background for the research carried out in this paper is both technical and business-oriented in nature. The technical background is needed for clear identification of the different roles and responsibilities, both in the fixed and mobile access network domain, as well as in how services and applications are offered to end-customers. The technical representation of the internet has historically grown and been represented in a layered principle. The OSI (Open Systems Interconnection) stack, for example, consists of seven layers, varying from the physical network link over different protocol layers to the upper application layers, providing as such a framework for characterizing the different functions of the communication system [6]. Another frequently used model is the “hourglass” , also referred to as the TCP/IP protocol suite, which consists of only 5 layers (physical, link, network, transport, and application). Other sources define the responsibilities in internet-based services based on locations in the network (backbone, access, building, home) and lifecycle phases (planning, deployment, operations and teardown) [11], but acknowledge the layered approach in the modelling. Apart from the layers itself, the technical specificities of the interaction between the different layers is also of importance. This interaction can be on a mobile network, a fixed network, between both types of networks (e.g. when a fixed access network is used as backhaul for mobile services), as well as between the applications and the networks (e.g. how VoIP signals are transferred over a network).

Apart from a technical perspective, this paper also starts from business-oriented and economic background. When operating in a competitive, multi-actor market, it is important to investigate the business case of each actor separately, as well as how interactions between different actors impact the outcome for the consumer. Here, we take into account two concepts: the business model framework, as developed by Osterwalder and Pigneur [7], and the value network proposed by Allee [1]. A business model describes the rationale of how an organization creates, delivers and captures value, thereby taking the point of view of one firm or organization. It compares the cost structure (key partners, activities, resources) of one firm to its revenue streams (customer relationships and segments, channels), through the eye of the value proposition the organization sets forward. A value network, on the other hand, describes the different roles - business activities - that need to be fulfilled in order to deliver the end-product, in this case broadband services, and focuses on the interaction between those roles. Interaction between roles can be tangible or intangible. Tangible assets are goods, services or monetary flows, transported through a contractual transaction, while intangible assets represent knowledge and benefits that support the core product and service, but are not contractual. In this paper, we will use ideas of both concepts, without following one of them to the letter.

By mapping a variety of identified cases in both the fixed and mobile networks and services domains, this paper tries to identify the successful revenue models in different settings. Making abstraction of physical network roles allows for defining and evaluating generic revenue models, based on three conceptual levels of responsibility: the offer, the delivery platform and the support platform. By using the identification of shared revenue streams to set up different financial models, the interaction between these levels of responsibility is further studied. As a final goal, the paper links the different financial models to business characteristics such as innovation tendency, sustainability, competition stimulus, etc. These guidelines can then be used by start-up companies when deciding about their financial model, by regulators to steer competition development, by established companies for making strategic decisions, etc.

After having given this short introduction to and motivation for our research, the next section will define the physical network roles, based on the layered principle described above, which serve as an underlying framework for clearly defining the different cases. Section 3 then defines the conceptual levels of responsibility (offer, delivery platform and support platform), as well as introduces their interaction through the concept of a financial model. The methodology is clarified by mapping a selection of cases in section 4, whereas section 5 analyzes all relevant financial models based on a number of business characteristics (related to competition, innovation, sustainability and standardization). Finally, section 6 summarizes the paper and lists the most relevant links between the business characteristics and financial models.

2 PHYSICAL NETWORK ROLES

Taking into account the layered principle of e.g. the OSI stack, as well as the technical specificities of both fixed and mobile networks and services, five different physical network roles were defined. These roles serve to unambiguously define the responsibilities each market player takes up in the various cases that will be studied in section 4, but will not be used for gaining insight in investigating the different business characteristics of the financial models.

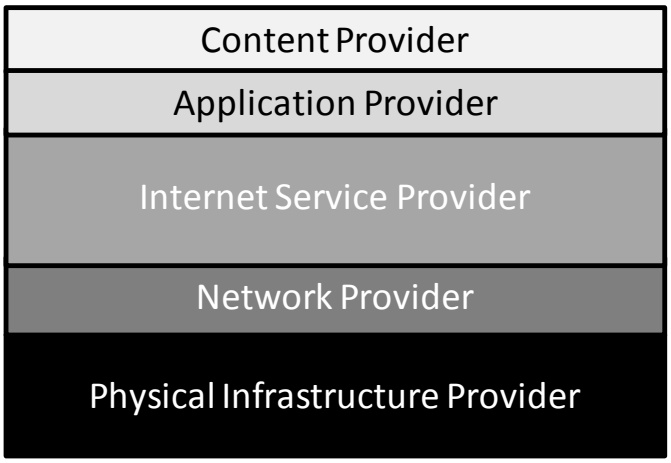


Figure 1: The physical network roles

The roles are represented in Figure 1 and defined as follows (from bottom to top):

- The **Physical Infrastructure Provider (PIP)** is responsible for the physical medium e.g. fiber, coax, UTP, etc.) needed to transfer data signals to the user equipment. The role of the PIP comprises of deploying and maintaining the passive infrastructure and equipment, which has no dynamic intelligence, but only provides a physical road structure for signal forwarding.
- The **Network Provider (NP)** is responsible for the active equipment used in providing this network connection, allowing for signals to be transmitted in between nodes of one network.
- The **Internet Service Provider (ISP)** provides reliable end-to-end connectivity over the entire internet, and is therefore in most cases directly connected to the customer. As such, the ISP is also responsible for maintaining customer relations (billing, administration, support) of the network connection used by the upper layers.
- The **Application Provider (AP)** is responsible for all software and hardware that use the network (internet) to provide the content to the user, mostly located at the endpoints of the network (user-side and server-side).
- The **Content Provider (CP)** is responsible for provisioning of the content that is offered to the user, directly or indirectly through the use of a specific application. This content is actually the only layer that is of value for the customer, and where the customer is willing to pay for.

Note that, although these roles are generically defined, they are not present in every case. Furthermore, if multiple media are present (e.g. a domestic wireless connection over a fixed backhaul), some roles may be duplicated (e.g. a wireless NP for the Wi-Fi access point, a fixed NP for the VDSL modem).

3 METHODOLOGY: RELATIVE ABSTRACT ROLES AND BUSINESS CHARACTERISTICS

As explained before, with every offer we can describe a set of roles which provides services to upper-layer roles. These roles can differ from case to case. In a wireless case for example, one perceives two layers of NP and PIP superposed. When providing fixed broadband we only have one such stack. When

looking at content provisioning the roles of application and content provider are added to these stacks etc.

This diversity in physical network roles makes it difficult to make sensible comparisons between different types of services. Yet, similarities exist. This paper therefore aims at setting up a generic framework, consisting of relative abstract roles and dedicated business characteristics, which can in a later step be used to evaluate different financial models.

The relative abstract roles defined in our analysis relate to the concepts of “offer”, “delivery platform” and “support platform”, all three are shortly explained below:

- **The offer** depicts what is being offered to the end customer. It denotes the valued content the customer wants to pay for, the value-adding part from the view of the user.
- **The delivery platform** can be seen as the enabler of the offer, and provides everything that is needed for a reliable and user-friendly transfer of the offer to the end-user.
- **The support platform** is the third and final abstract role, and responsible for making the connection to another host. It can be seen as the underlying transport medium, which can have different levels of dynamicity and intelligence.

When combining these three abstract roles with the general role of “customer” (the end-user who is willing to pay for the service or application), and adding revenue streams, different financial models can be created. As such, the financial streams that are used to pay for the value that is provided from one role to the other can be analyzed. An example of a financial model is given in Figure 2, more concrete example cases will be given in section 4 and an overview of all relevant financial models can be found in section 5.

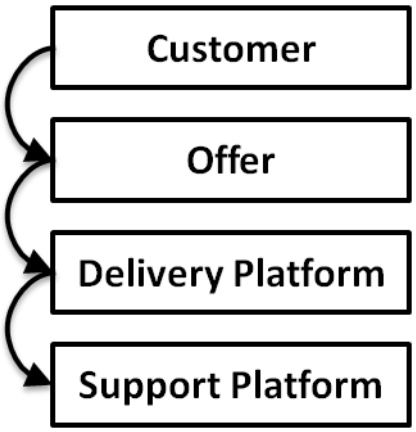


Figure 2: An example of a financial model (the Waterfall type)

Each of these roles faces costs when providing value to the other layers. In order to analyze and compare different financial models, dedicated business characteristics are set up that investigate the impact of the money flows:

- **Offer and technology innovation:** investigate the incentive of the different abstract roles to develop new services, both on the offer role (development of new mobile applications, services, content etc.) and the technology platforms (both delivery and support platform:

deployment of new networks or upgrades of existing ones, development of new mobile operating systems, etc.)

- **Inter-layer power distribution**: looks into how the power is spread amongst the relative abstract roles. Is there one role that steers everything, or does every role have the same amount of linkages and power?
- **Intra-layer competition:** studies the possibility of the financial model to stimulate horizontal competition, i.e. competition in between different offers, different delivery platforms or different support platforms separately.
- **Sustainability**: investigates the economic viability of the model: does every relative abstract role gets paid according to its required resources and incurred costs.
- **Standardization**: searches for the need to standardize certain protocols in order to attract more customers.

4 EXAMPLE CASES: MAPPING PHYSICAL NETWORK ROLES TO RELATIVE ABSTRACT ROLES

The methodology of defining physical network roles, relative abstract roles and financial models was generically explained in the previous sections. To make this methodology more concrete, this section will apply it to four representative cases, which serve as a basis for the analysis in section 5. The financial models applicable to the cases are already mentioned in this section, but for a more detailed description and analysis, we again refer to section 5.

4.1 SHAZAM FOR SMARTPHONES

The first case that will be discussed is the Shazam application for smartphones. Shazam is a service that allows people with a smartphone to record an audio fragment of a song and identify its title and artist. The audio fragment is encoded into a digital fingerprint on the smartphone and sent over the internet to the Shazam servers. There, the digital fingerprint is compared to a database which returns matching information about the song.

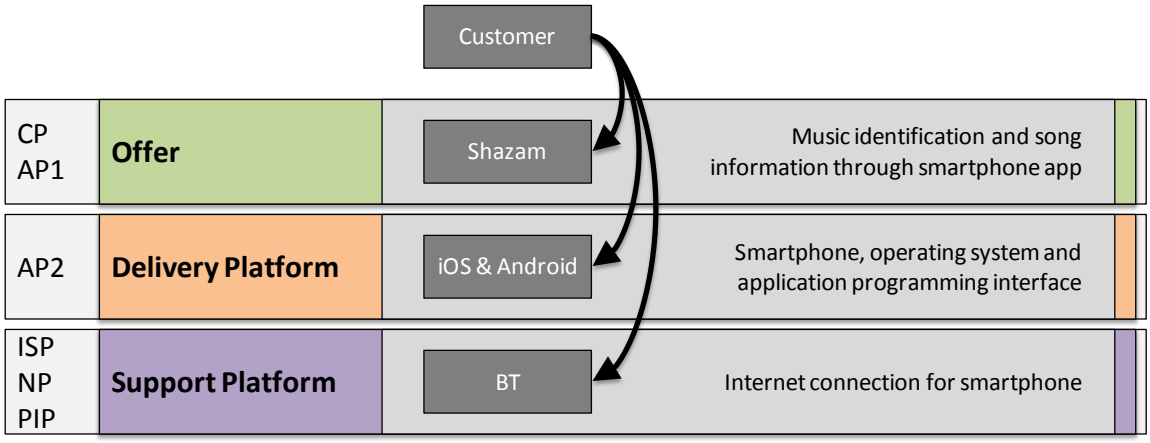


Figure 3: Mapping physical network roles and relative abstract roles: the exemplary case of the Shazam application (Pure OTT)

The important aspects of the value chain are modeled in the Figure 3. The user has a smartphone (application provider 2) on which the Shazam application is installed (application provider 1). The backhauling of the fingerprint appears over the active internet connection on that phone (whether it's mobile or through a domestic Wi-Fi access point is irrelevant). The valued content that is then delivered to the end-user is the relevant information about the song (performer, title, length, etc.).

A functioning song identification application is the main offer made by the Shazam business model. The application requires a smartphone with the right operating system to run it: the delivery platform. The internet connection (including three physical network roles: ISP, NP, PIP) can be identified as the support platform.

This case is exemplary for the Pure OTT (Over-The-Top) financial model. The user is responsible for purchasing the three technologies in the user-stack separately. The user buys a smart phone containing the right operating system from a phone vendor and purchases an internet connection from its local ISP. Using this internet connection, Shazam is then bought from the respective phone's operating system's application store (e.g. App Store, Google Play, Windows Market Place).

Note that, although we only focused on Shazam to give one specific example, this financial model is applicable to a whole range of mobile apps, e.g. Viber, different games, What's App etc.

4.2 KINDLE

The Kindle is an e-reader (or e-book reader) that allows to search, download and read different papers, books, newsletters, magazines, etc. on the device. By using the e-Ink electronic paper, the Kindle screen looks like a real book, thereby increasing the reading experience quality while minimizing battery consumption. The customer buys the books from the editor of his choice (the valued content, or the offer), and the e-reader device from Kindle. This device can be seen as the delivery platform. When buying a Kindle, a lifelong 3G contract is frequently included.

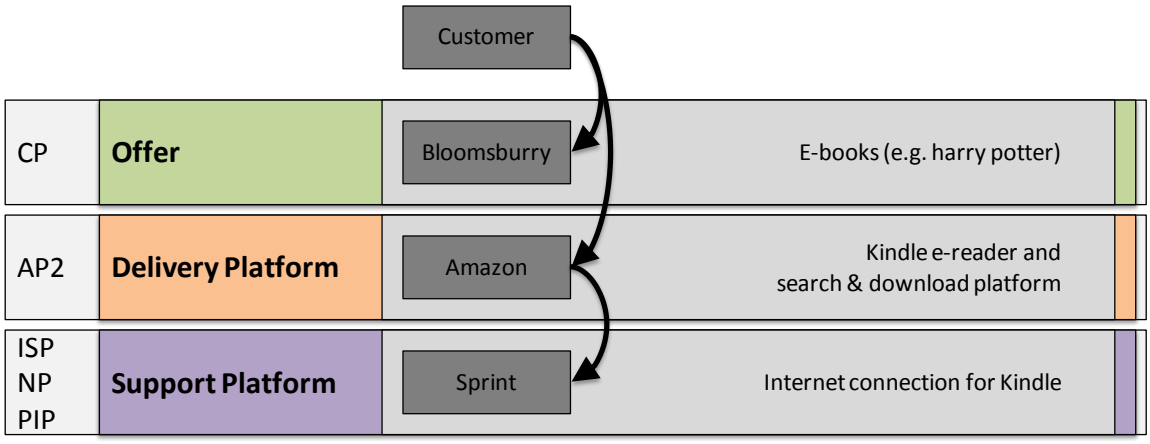


Figure 4: Mapping physical network roles and relative abstract roles: the exemplary case of the Kindle e-reader (Platform-Connected)

Although this example case looks very similar to the example of Shazam, the financial model applied differs. Kindle is an example of the Platform-Connected financial model, where the customer pays for

the offer and delivery platform separately, and where the support platform is financed through the delivery platform (the internet connection is paid by Amazon).

4.3 DOMESTIC INTERNET

The classical internet hierarchy is well known. It contains a service provider that sells internet access to individual households and customers and administers a part of the IP pool. This internet provider requires connectivity between its central office and the various households. The connectivity is not necessarily provided in-house but can be bought as wholesale access. This wholesale network provider installs and maintains the active network equipment and in turn needs to lease access from the physical infrastructure medium (e.g. copper, coaxial cable or dark fiber). The roles are graphically represented in Figure 5 for the specific case of the Fiber-to-the-Home (FTTH) network in Stockholm, Sweden.

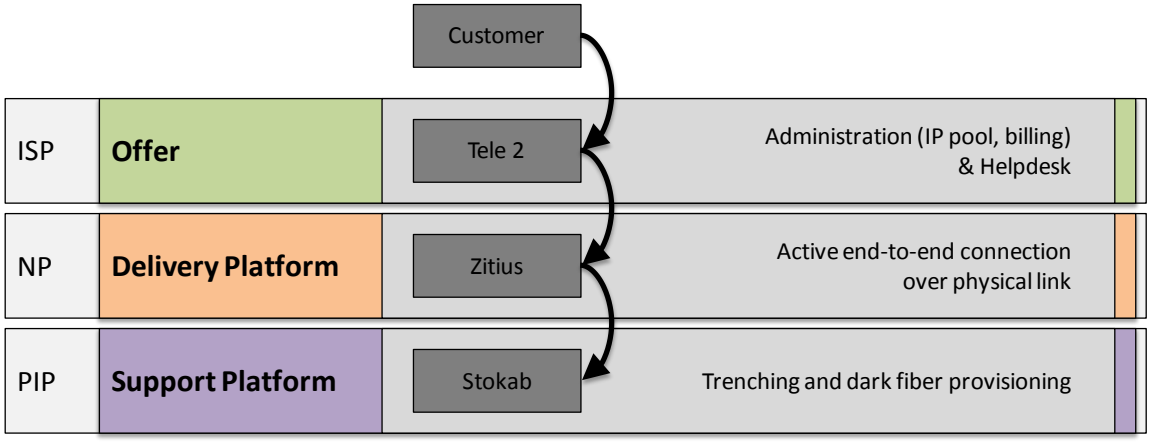


Figure 5: Mapping physical network roles and relative abstract roles: the exemplary case of FTTH connection in Stockholm (Waterfall)

This setup leads to the Waterfall model in which the financial streams follow a waterfall from offer to delivery platform to support platform. The customer only directly interacts with the service provider. The latter buys wholesale or bitstream access from the network provider. The network provider in turn leases the physical infrastructure from the PIP.

4.4 TV ON DEMAND IN TRIPLE PLAY PACKAGE (SPORTS CHANNEL)

In this case there is a service provider who sells a triple play package containing voice, internet and a basic set of digital TV channels. Customers have the option of purchasing on demand, pay-per-view content such as live broadcasts of sport events. The triple play service provider has license agreements with the various on demand content providers as well as with the always-on TV channels. He also buys network connectivity from underlying network operators. The example given includes a triple play pack offered by the Flemish cable operator: Telenet (Figure 6).

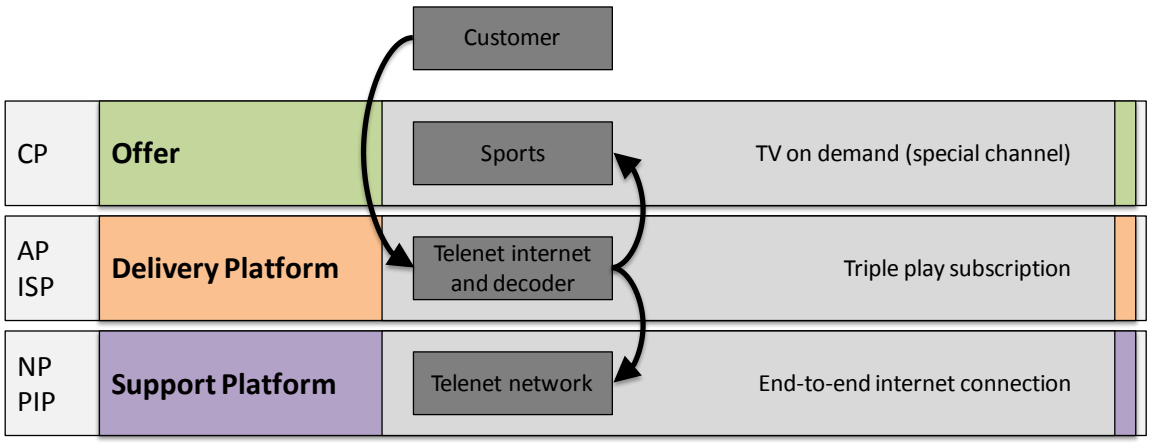


Figure 6: Mapping physical network roles and relative abstract roles: the exemplary case of TV on demand in a triple play package (Delivery-Steered)

This example not only shows another grouping of the physical network roles in relative abstract roles, but is furthermore a good example of the Delivery-Steered financial model, in which the customer pays the delivery platform, which in turns pays the offer (the sports channel broadcaster) and the support platform (Telenet itself in this case).

4.5 CONCLUSION

This section presented an overview of cases in order to detail and explain the mapping of physical network roles (as defined in section 2) to the relative abstract roles introduced in this paper (section 3). The examples clearly show the differences between both types of roles: while the physical network roles are fixed to a clearly defined layer in the network and service offering, the relative abstract roles are more generic. This generic character of the abstract roles makes it possible to map them on different types of service offerings, while still holding the possibility to compare them.

By not only indentifying the relative abstract roles in each case, but also including their interactions in form of revenue streams, they can be mapped to different financial models. Exactly these models will be used in the next section to analyze the business characteristics.

5 ANALYSIS AND DISCUSSION: CAN WE DRAW GENERIC CONCLUSIONS FROM THE IDENTIFIED FINANCIAL MODELS?

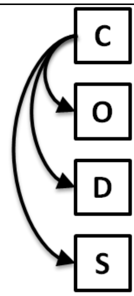
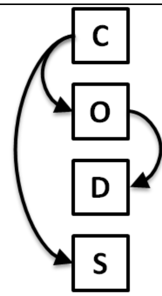
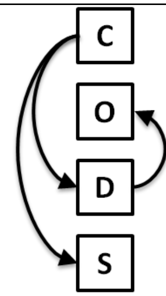
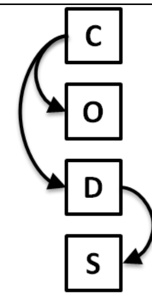
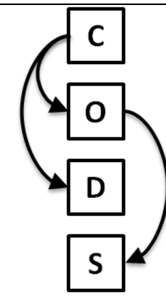
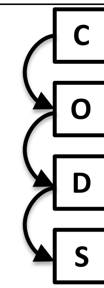
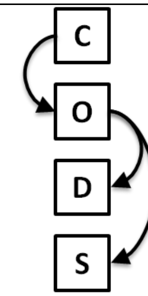
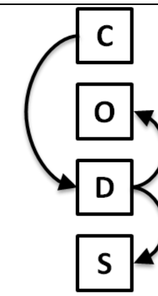
Starting from the identified models in the described cases made us consider the financial models more generically by listing all possible combinations of revenue streams. We assume that every role gets incoming financial transfers from only one other role. We also introduce “customer” as a dummy role which only pays. Finally, we assume that roles can’t pay themselves. Under these assumptions we have 3^3 (27) unique financial models.

From these 27 we have filtered 8 using the following criteria:

- We removed all models where no financial flows enter the collection of cost bearing roles (offer, delivery platform, support platform), since they can never be sustainable.
- We further removed the models in which two roles pay each other forming a payment cycle. These types of models can be easily simplified to another one without payment cycle (by subtracting the two revenue flows and only keeping the net flow).
- We removed the models in which the support platform pays the higher roles. It seemed illogical for a transport medium, that should be neutral, to pay (and as such favor) an upper layer.
- Finally, one extra model was removed for consisting of a payment spiral (customer pays delivery platform, delivery platform pays offer and offer pays support platform). No realistic examples for this financial model were found.

As explained before, the size and direction of the financial flows results in the presence or absence of certain pressures the financial model undergoes with respect to innovation, competition, sustainability and standardization. The remainder of this section will therefore discuss the eight selected models with respect to these business characteristics, and link to concrete examples where applicable (Table 1). The analysis will be grouped into three categories according to similarities with respect to the proposed business characteristics: Over-The-Top (OTT) models, Indirect Support models and Single Interaction Point models.

Table 1: Overview and analysis of selected financial models according to business characteristics

	1	2	3	4	5	6	7	8
Name	**Pure OTT**	**Offer-Central OTT**	**Delivery-Central OTT**	**Platform-Connected**	**Delivery-Independent**	**Waterfall**	**Offer-Steered**	**Delivery-Steered**
Customer Offer Delivery Platform Support Platform								
Type	**OVER-THE-TOP**			**INDIRECT SUPPORT**		**SINGLE INTERACTION POINT**		
Examples	Most mobile apps (e.g Shazam)	Skype, Steam	Video on Demand service	Kindle	Cellular telephony (GSM)	Domestic internet	Fixed voice subscription including phone	GPS, triple-play shakes
Offer innovation / diversity	+	+	-	+/-	+	+	+	-
Technological innovation	-	-	-	+	+	+	+	+
Inter-layer power distribution	+	+/-	+/-	+/-	+/-	+/-	-	-
Intra-layer competition	+	+	+/-	+/-	+	+	+/-	-
Sustainability	-	-	-	+/-	+/-	+	+	+
Standardization	+	+	+/-	+/-	+	-	-	-

5.1 OVER-THE-TOP (OTT) MODELS

Over-The-Top models owe their name to the fact that customers subscribe or purchase the support platform independently from the offer and/or delivery platform. The latter two host services which run on the support platform in an OTT manner, i.e. without incurring a direct revenue link. We encounter three variants within this type of models. First, there is, the Pure OTT model where the customer independently interacts with all three layers. In the two remaining models, the Offer-Central and Delivery-Central model, the customer has only one interaction point apart from the support platform (the offer and delivery platform respectively).

Cases that exemplify these models can be found among the various web based applications that are hosted Over-The-Top of the user's domestic or mobile internet connection. Often, the device (pc, smart phone etc.) and operation system, which together constitute the delivery platform, are also bought independently by the consumer. In this case the model fits the Pure OTT classification, e.g. when Shazam is installed on the user's smart phone (see section 4.1). In case the offer pays the delivery platform, we identify the Offer-Central financial model (e.g. for Skype or Steam, where the customer pays for call minutes or video games, which in turn is used to fund the application itself). The Delivery-Central model, finally, can be found in applications where the delivery platform pays the offer, for example in a Video On Demand (VOD) service in which the VOD platform pays for the licenses of the movies.

Although OTT services are getting increasingly popular, they can be problematic with respect to sustainability, for two reasons. First, the lack of linkage between the support platform and either the offer or delivery platform allows for a discrepancy between the support platform's income and its cost structure. As the end-user pays for the platform independently of the amount of offers or delivery platforms he subscribes to, the platform is compensated equally if it is used for supporting only one service as it is when supporting multiple services. An increase in average support platform prices to counter this problem would in turn lead to a lemons problem where only heavy users will be willing to pay the prices.

A second problem with respect to sustainability is that some of the OTT offers compete with services the support platform provider offers himself. A nice example is VOIP services, which form direct competition with the incumbent telephone providers. Not occasionally, this incumbent telephony provider is also the provider for domestic internet which in turn forms the support platform for VOIP calls. A reaction would be for this provider to use deep packet inspection to block VOIP traffic or use higher charges for VOIP traffic. This however is not in compliance with the idea of net neutrality, the notion that all traffic should be treated the same. This is a topic of much debate and merited to be mentioned. An in-depth discussion on the other hand on the pros and contras of enforcing net neutrality is outside the scope of this manuscript. Interested readers are referred to [5].

Both these problems reduce the appeal of fulfilling the role of support platform provider; this undermines the sustainability of the model. It also has negative implications on the willingness of the support platform provider to invest in new technology (negative influence on technological innovation).

Standardization on the other hand is favorable among these models. A lack of standardization would lead to financial inefficiencies at the offer providers when for example the same application has to be developed for multiple platforms. Because the support and possibly the delivery platform directly compete for customers, they are inclined to adhere to certain standards to not lose customers whose

favorite offer does not work on their platform. To an extent multiple platforms are still existent but today many smart phone providers use Android instead of each developing their own standard (e.g. Samsung, Huawei, etc.) and furthermore web browsers become compatible with W3C and JavaScript standards for browser-based applications.

The impact on the other indicators is less clear and can differ from model to model. Offer innovation and intra-layer competition for example are generally favorable in this model due to the standardization which reduces barriers to entry except in the case of the Delivery-Central OTT implementation. In this model, the consumer purchases the delivery platform and is limited to the offers the delivery platform holds under license. When subscribing to Netflix for example, one is limited to the films Netflix streams. This increases barriers to entry for new offer providers and reduces both offer innovation and inter-layer competition. In this Delivery-Central model, power is also concentrated with the delivery platform, lowering the score on inter-layer power distribution.

5.2 INDIRECT SUPPORT MODELS

Indirect support models are characterized by a direct and independent connection from the customer to the offer and delivery platform as well as by the absence of a direct connection between the customer and the support platform. The latter fact contrasts these models with the OTT models in which the customer contacts the support platform.

Two variants exist. In the Platform-Connected Model, the support platform is linked through the delivery platform, hence the name. In the Delivery-Independent variant, the support platform is linked through the offer and the delivery platform is purchased independently. Buying an e-reader (e.g. Kindle, see section 4.2) with comes with a lifetime 3G subscription is an example of the Platform-Connected model, while cellular telephony (GSM) is an example of the Platform-Connected financial model, as the customer pays for the operator for voice and data traffic (calls and sms - offer), which in turns pays for the connection (support platform), while the mobile phone is purchased separately (delivery platform)

In the first place, these models partially reduce the sustainability and technological innovation issues encountered in the OTT models as the income and cost structure of the support platform can be matched more easily using contracts between the support platform and either the delivery platform or offer. These contracts can also be used to provide an incentive to the support platform to innovate his infrastructure. The fact that the offer and delivery platform are not directly connected remains however an issue with regards to sustainability.

The power distribution among the layers is slightly less evenly, as the layer which serves as a link between the customer and support platform somewhat concentrates power. For the support platform the threat of losing this contract is more severe than losing a single customer in the OTT models. Nevertheless, with respect to standardization this model is still fairly favorable. The aforementioned disconnect between offer and delivery still incentivizes the delivery platform to adhere to standards as not to scare away customers favoring a certain incompatible offer. The support platform however, might be cornered into adhering to some private standards through the asymmetric power relation described before. Consequently, also offer innovation and horizontal competition remain reasonably favorable.

5.3 SINGLE INTERACTION POINT MODELS

In Single Interaction Point models, the customer has only one link with the providers in the value chain. The other players are indirectly compensated. Three variants exist. The Waterfall model in which the offer contracts the delivery platform which in turn contracts the support platform is the classical implementation of a vertically disintegrated access network for domestic internet (section 4.3). In the two remaining models the access point for the customers contracts both other layers. These are called the Offer-Steered and Delivery-Steered models respectively, indicating the central position of that role.

Examples can be found in the realm of navigation products where the customer buys a GPS device and the device manufacturer pays for the licenses on maps as well as the satellite connection (Delivery-Steered Model). Another example for the Delivery-Steered model can be found in the provisioning of triple play shakes (section 4.4). The Offer-Steered model can be found in other types of bundled services, e.g. in a GSM subscription with included phone. The customer pays for the voice and data to the operator, which in turn purchases the mobile phone and provides for the connection.

In this type of models, power is often concentrated at the layer with which the customer interacts as this layer controls the only link through which money flows into the value chain. The power concentration is less severe in the Waterfall model because the single interaction point now does not directly connect with the support platform, removing some of its leverage power.

Nevertheless these models score better with respect to sustainability since the other roles are paid through business to business interactions which allows for an easy matching of platform usage and remuneration. The fact that the support platform is linked through business to business interactions also facilitates technological innovation. If higher layers need improved QOS of lower layers, e.g. higher bandwidth, they can directly communicate and incentivize their partners with adjusted contracts. This way technological innovation appears in a pull way contrary to OTT where technological innovation appears in a push form.

Standardization on the other hand suffers in this model. The concentration of power will allow certain players to impose their private communication standards onto the other layers. Nevertheless does this lack of standardization not necessarily impede offer innovation and diversity. The role of single interaction point is attractive and induces competition among offer providers. This relationship does not hold for the Delivery-Steered model where the single interaction point is not situated on the offer layer but on the delivery platform layer. On this layer the probability of an oligopoly is much higher and barriers to entry reduce competition and consequently offer innovation.

5.4 GENERAL CONCLUSIONS

Although analyzing the different models separately is useful, some general conclusions can also be drawn by making the links between the different business characteristics mutually and the type or category of financial model. Three main trends can be observed.

First, if the platform is paid independently of the higher layer, then there is an incentive to adjust to standards. If there is a direct link between two companies, they might agree on a separate protocol, not necessarily confining to the standards. Standardization itself promotes intra-layer competition because it reduces barriers to entry. The other way around is not always true: if there is no standardization, there still can be intra-layer competition if the market is attractive enough. The link between standardization

and inter-layer power distribution can furthermore also be made. This link is bidirectional: when power is highly concentrated in a single layer, its companies' private protocol can be enforced upon the other layers, resulting in a lock-in. On the other hand, standardization undermines the potential power concentration. Finally, it is worthwhile to mention that inter-layer power concentration is always stronger if the arrow goes up (because of compliance to underlying protocols, see Delivery-Central and Delivery-Steered models).

A second observed trend sketches the link between sustainability and innovation, specifically technological innovation. Both these are benefited by direct linkages between the different layers because they make sure that every layer is charged for what it offers in a direct manner. This allows alignment between cost structure and income. Direct links furthermore have the added benefit of using contracts to steer innovation. Over-The-Top models on the other hand risk free-riding behavior, as there is no direct revenue link between the consumed resource (e.g. bandwidth) and the offer (e.g. YouTube).

Innovation and diversity on the offer layer, finally, is influenced both by standardization, as well as the presence of a direct link between the customer and the offer. The former makes it easier to develop more offers ("cost side"), while the latter makes it more attractive ("revenue side").

6 CONCLUSION

Because of the observed trend towards the involvement of multiple actors in offering telecommunications networks, services and applications on the one hand, and the variety of models depicting the interactions between these actors on the other, this paper aimed at developing a generic role structure for describing and analyzing these cases. Although various cases can be described using a set of physical network roles (content provider, application provider, internet service provider, network provider, physical infrastructure provider), the number of possible combinations, and the possibility of duplicating roles (e.g. a mobile network operator using a fixed network operator for backhauling purposes) makes it very difficult to find commonalities amongst different types of networks or services.

This paper therefore introduced three relative abstract roles, which depict also a responsibility in the service offering to the end-customer, but are not fixed to a network role. The service the customer is willing to pay for, is specified by the offer and enabled through the delivery platform. The support platform, as a third role, is the underlying transport infrastructure necessary to operate delivery platforms.

By defining the interactions between these three relative abstract roles as revenue streams, financial models can be formed. In a next step, they are analyzed using different business characteristics, which focus on competition, innovation, sustainability and standardization. These characteristics are influenced by the presence and direction of the revenue streams between the roles.

From the analysis, we see that Over-The-Top models are favorable for standardization, but suffer on sustainability and technological innovation. For the Single Interaction Point models, we observe the

opposite: they are sustainable and support technological innovation through private standards. The Indirect Support models, finally, form a balance between these two extremes: they are also beneficial for technological innovation, but do not induce the same levels of power concentration as in the Single Interaction Point models.

We furthermore observe a relation between some of the identified business characteristics. Sustainable models tend to promote technological innovation, while standardization links to enhanced competition. Innovation on the offer layer finally is benefited both by standards as well as a direct connection between customer and the offer itself.

References

[1] Allee, V. (2000) *Reconfiguring the Value Network.* Journal of Business Strategy, 21(4).

[2] B. M. C. N. V. Dienst Pers en Informatie, Ed. (1982), *Bell Telephone Manufacturing Company*. Antwerp: Imperama N.V.

[3] European Commission. (1987) *Green Paper on the development of the common market for telecommunications services and equipment.* Commission of the European Communities.

[4] Evenepoel, S. et al. (2012). *Municipal Wi-Fi value network configurations : impact of motivations, pricing and topology*. Presented at CTTE, Athens, Greece.

[5] Krämer, J., Wiewiorra, L. et al. (forthcoming) *Net neutrality: A progress report.* Telecommunications Policy.

[6] Kurose, J. and Ross, K. (2008) *Computer Networking: A top-down Approach Featuring the Internet*. Pearson Education India.

[7] Osterwalder, A. and Pigneur, Y. (2010) *Business Model Generation*.

[8] Varoutas, D., Katsianis, D., Sphicopoulos, T.H., Stordahl, K. and Welling, I. (2006). *On the Economics of 3G Mobile Virtual Network Operators (MVNOs).* Wireless Personal Communications, 36, 129-142.

[9] Van Der Wee, M. et al. (2011). *Making a success of FTTH – learning from case studies in Europe*. Journal of the Institute of Telecommunications Professionals, 5 (4).

[10] Verbrugge, S., Casier, K. and Mas Machuca, C. (2012). *Business Models and their costs for next generation access optical networks.* ICTON, Coventry, UK.

[11] Verbrugge, S. et al. (2011) *Research approach towards the profitability of future FTTH business models.* IEEE Future Network & Mobile Summit (FutureNetw).

[12] Willinger, W. and Doyle, J. (2002) *Robustness and the Internet: Design and evolution.* Robust design: a repertoire of biological, ecological, and engineering case studies 1100.